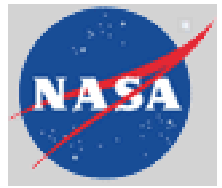




AMA



NASA Weather Accident Prevention Annual Project Review Weather Data-Link Market Survey

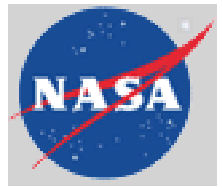
Aviation Management Associates

Arthur Feinberg

November 20, 2002



AMA

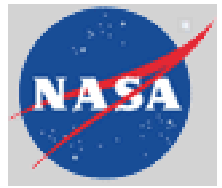


Program Objectives

- Conduct a market survey of companies providing or proposing to provide graphical weather information to the GA cockpit
- Analyze market survey results to compare system, service and product offerings
- Identify system, service or product area constraints which could benefit from additional R&D technology investment



AMA



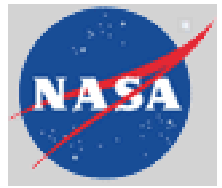
GA Market Survey of Weather **Data-Link Products**

Vendors

- AirCell, Inc.
- UPS Aviation Technologies
- Echo Flight
- Satelink Technologies, Inc.
- WSI
- Jeppesen
- Flytimer
- Goodrich
- Garmin
- Avidyne Corp.
- ControlVision
- Arnav
- Honeywell
- Bendix/King
- Rockwell Collins
- Universal Avionics



AMA



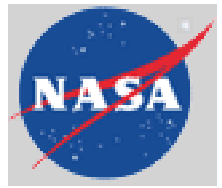
Market Survey Data Collection

Categories

- Product Availability
- Recurring and Non-recurring Costs
- Weather Data Sources and Products Provided
- Communication Data Links
- Applicable GA Aircraft
- Certified Avionics/Wx. Data Sources
- Product System Technical Specifications
- Display Capabilities and Characteristics



AMA



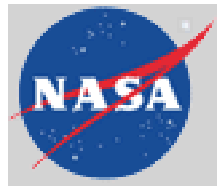
Market Survey Results

Data-Link Implementations:

- Cellular/Ground-Based
 - AirCell, UPS Aviation Technologies, ControlVision, Jeppesen
- Low Earth Orbiting (LEO) Satellites
 - Echo Flight, Garmin, Avidyne, Arnav, ControlVision



AMA



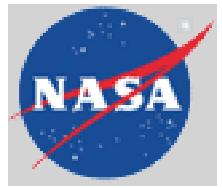
Market Survey Results

Data-Link Implementations:

- Geosynchronous Satellite (GEO)
 - Satellite Technologies, WSI, UPS Aviation Technologies
- VHF/FIS-B Ground-Based
 - Arnav, Honeywell Bendix/King
- ARINC ACARS
 - Rockwell Collins, Flytimer



AMA



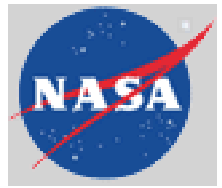
Market Survey Results

GA Cockpit Weather Display Options:

- A/C Multifunction Displays (MFDs)
 - Garmin 430 & 530 (Echo Flight, Garmin)
 - Apollo MX-20 (AirCell, UPS Aviation Technologies)
 - MFD-5200 (ARNAV)
 - KMD-550 & 850 (Honeywell Bendix/King)
 - Adaptive Flight Display 3010E (Rockwell Collins)
 - FlightMax (Avidyne)



AMA



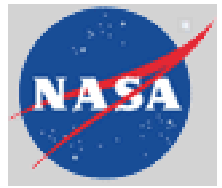
Market Survey Results

GA Cockpit Weather Display Options:

- Portable Graphic Weather Displays
 - Flight Cheetah FL270 & Laptop (Echo Flight)
 - PDAs & Laptops (AirCell, Merlin)
 - PDAs (ControlVision, ARNAV, WSI)



AMA

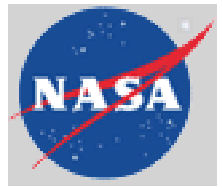


Analysis Results

- **Communications Data Link:**
 - Cellular: Provides voice and data communications at a price of \$2/minute
 - Ground Based VHF: Broadcast service with frequent updates while coverage good only above 5,000' AGL
 - LEO Satellite Request/Reply Service: Weather data updates may be too infrequent (charge per request)
 - GEO Satellite Broadcast Service: Good coverage with frequent updates but recurring costs >\$500/year
 - UAT Broadcast: FAA selected GA data link although no current commercial weather service providers



AMA

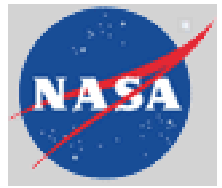


Analysis Results

- **Recurring and Non-Recurring Costs:**
 - Non-Recurring Cost-Driver is MFD in Most Cases
 - Recurring Costs appear to be Within User Acceptance Criteria for Weather Graphics



AMA

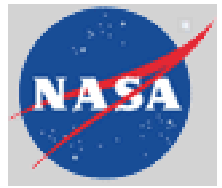


Analysis Results

- **Avionics Display Functionality:**
 - All MFD's display operational information and allow graphical weather to be overlaid
 - No standard between commercial offerings
 - Like colors constrain the overlay of weather graphics with some operational information
 - IPAQ display offerings inconsistent
 - One offering displays static graphic weather images
 - One offering provides similar functionality to MFDs



AMA

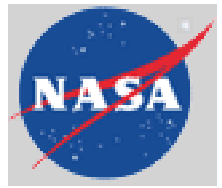


Analysis Results

- **Weather Products – GA Weather Needs:**
 - Weather that affects GA decisionmaking:
 - Convection location and short-term forecasts
 - Areas of known icing and short-term forecasts
 - Winds at flight altitude
 - Cloud top/bottom
 - En Route and destination visibility (combined with clouds for VFR or IFR conditions); Slant range vis.
 - Low level wind shear/Crosswind component
 - Volcanic Ash location and forecasted movement



AMA

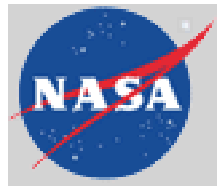


Conclusions

- Graphical weather cost reductions required for increased GA market penetration:
 - Avionics (MFDs) too expensive for most GA
 - Subscription service costs also a consideration
- Satellite regional broadcasts with local ground-based broadcasts may be optimal
- GA graphical weather needs not well defined or standardized



AMA

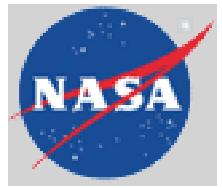


Recommendations

- **Flight Test & Evaluate Commercial Weather Data Link Systems**
 - Conduct objective evaluation using GA aircraft and diverse group of GA pilots
 - Assess performance of strategic flight planning
 - Investigate GA tactical weather avoidance
 - Compare quality and timeliness of weather data



AMA



Recommendations

- **Evaluate Hybrid Satellite and Ground Based Architecture for Aviation Weather**
 - Assess benefits and tradeoffs to implement
 - Satellite broadcasts for national/regional data
 - Ground-based broadcast for local weather data
 - VHF (VDL-2/3) and/or UAT for ground-based
 - GEO or SDARS for satellite broadcast service